Preface

This thesis outlines the work done on alumina to alumina joining The introductory chapter discusses the importance and advantages of ceramic joining along with different methods currently employed and mechanisms involved Ceramic-to-ceramic and ceramic-to-metal joining are described The structure and properties of alumina ceramics are presented along with a review of earlier literature on alumina ceramic joining Relevant properties of refractory cements are discussed and the objective and scope of the work are outlined The second chapter describes the synthesis of refractory cements using wet-chemical methods and the experimental techniques employed for the preparation and characterization of the alumina joints

The third chapter describes the results obtained by the reaction bonding of alumina ceramics Aluminates of Ca, Ba and Mg are prepared using Gel – Crystallite conversion method and their alumina joining property was compared Calcium aluminates were found to be the promising refractory cements Crystalline phases having 1 1, 2 1 and 3 1 CaO to Al_2O_3 ratio in CaO - Al_2O_3 system were prepared by wet chemical methods The C_3A composition is found to be the most advantageous for alumina joint formation at 1450°C, giving rise to the joint strengths comparable to that of commercial alundum cement joined alumina ceramics The joints made with aqueous paste of cementing powder were treated at different atmospheres and dried before firing at elevated temperature of 1200-1550^{0}C

A simple tensile and bending strength measurement apparatus were fabricated to compare the relative strengths of joints Comparative results of the joint strengths, carried out using simple pulling and bending strength measurement techniques are presented With the help of XRD and SEM evidences, the mechanism of alumina joining by C_3A is attributed to the reaction of the calcium aluminate phase with the substrate alumina specimens, thus giving rise to the formation of low temperature melting $Ca_{12}Al_{14}O_{33}$ phase The formation of reaction products is in agreement with the phase diagram of calcium oxide–aluminium oxide system under normal condition (i e in the presence of O_2 + H_2O containing air) The tensile strength measurement results indicate that C_3A phase showed strength in the range of 30-60 kg/cm^2

Studies conducted on the sinter bonding of alumina are described in the fourth chapter The joining of alumina ceramics was achieved using mainly two types of alumina powders with and without the addition of sintering aid A particular composition of barium aluminum titanate was prepared and studied for its ability of enhancing sintering in alumina The role of microcracks and surface cracks formed during the joining process or fracturing are viewed as possible strength reducing factors